



Sequence Listing

<110> Walter Reed Army Institute of Research
Lanar, David E.
Hillier, Collette J.
Lyon, Jeffrey A.
Angov, Evelina
Kumar, Sanjai
Rogers, William
Barbosa, Arnolndo

<120> Expression, Purification, and Uses of a *Plasmodium falciparum* Liver Stage Antigen 1 Polypeptide

<130> 003/285/SAP

<140> 10/706,435

<141> 2003-11-12

<150> 60/425,719

<151> 2002-11-12

<160> 28

<170> Microsoft Word XP

<210> 1
<211> 17
<212> PRT
<213> *P. falciparum* LSA-1
<220>
<223> LSA-1 major 17 amino acid repeat
<400> 1

Glu Gln Gln Ser Asp Leu Glu Gln Glu Arg
5 10

Leu Ala Lys Glu Lys Leu Gln
15

<210> 2
<211> 17
<212> PRT
<213> *P. falciparum* LSA-1
<220>
<223> LSA-1 minor 17 amino acid repeat
<400> 2

Glu Gln Gln Arg Asp Leu Glu Gln Glu Arg
5 10

Leu Ala Lys Glu Lys Leu Gln
15

<210> 3
 <211> 1374
 <212> DNA
 <213> Artificial sequence
 <220>
 <223> LSA-NRC (H) Mut
 <400> 3

atgggtacca	acagcgaaaa	agacgaaatt	atcaaaagca	40
atctccgctc	cgcgagctcc	aacagccgca	accgcataa	80
cgagggaaaag	catgagaaga	aacatgtgct	gagccacaac	120
tcctacgaga	agactaaaaaa	caacgaaaac	aacaaattct	160
ttgacaagga	caaagagctg	acgatgagca	acgttaaaaa	200
cgtatcccag	accaacttta	aatccctcct	gcgcaacctc	240
ggcggttccg	agaacatctt	tctcaaagaa	aacaaactga	280
acaagaagg	caaactgatt	gaacatatac	tcaacgacga	320
cgatgacaaa	aaaaaaataca	ttaaaggcca	ggatgaaaat	360
cgccaggaag	acctcgaaga	aaaagctgct	gaacagcagt	400
cgggacctgga	acaggagcgc	ctcgctaaag	aaaagctcca	440
ggagcgccctc	gctaaagaaa	agctccagga	gcaacagcgc	480
gacctggaac	agcgcaaggc	tgacacgaaa	aaaaaacctgg	520
aacgcaaaaaa	ggaacacggc	gacgttctgg	ctgaggacct	560
gtacggccgc	ctggaaatcc	cagctatcga	actcccatcc	600
gaaaacgaac	gcggctacta	catcccacac	cagagcagcc	640
tgccacaaga	taatcgcggg	aactcccgcg	acagtaagga	680
aatcagcata	atcgaaaaaa	ccaaccgcga	aagcattacc	720
accaacgtgg	aaggccgccc	cgacatccac	aaaggccacc	760
tcgaagaaaa	gaaagacggc	tccatcaaac	cagaacagaa	800
agaagacaaa	agcgctgata	tccagaacca	caccctggag	840
accgtgaaca	ttagcgacgt	gaacgacttc	cagatcagca	880
agtacgagga	cgaaatctcc	gctgaatacg	atgactccct	920
gatcgacgaa	gaagaagacg	acgaagatct	ggatgaattc	960
aaaccaattg	tccagtacga	taactttcag	gacgaagaaa	1000
atatcgcat	ttacaaaagaa	ctcgaagacc	tcatcgagaa	1040
aaacgaaaac	ctggacgacc	tggacgaagg	catcgaaaaa	1080
tcctcgaag	aactgagcga	agaaaaaaatc	aaaaaaaggca	1120
agaaatacga	aaaaaccaag	gacaacaact	tcaaacccaaa	1160
cgacaaatcc	ctctacgacg	agcacattaa	aaaatacataa	1200
aacgacaagc	aagtgaacaa	ggaaaaggaa	aaatttatca	1240
aatcccttt	ccacatttc	gatggcgata	acgaaattct	1280
gcaaattgta	gacgaacggt	tgagcgaaga	catcaactaaa	1320
tacttcatga	agcttggggg	ctccgggtct	ccacaccacc	1360
accaccacca	ctga			1374

<210> 4
 <211> 457
 <212> PRT
 <213> Artificial sequence
 <220>
 <223> LSA-NRC (H) Mut
 <400> 4

Met	Gly	Thr	Asn	Ser	Glu	Lys	Asp	Glu	Ile	
					5					10
Ile	Lys	Ser	Asn	Leu	Arg	Ser	Gly	Ser	Ser	
					15					20
Asn	Ser	Arg	Asn	Arg	Ile	Asn	Glu	Glu	Lys	
					25					30
His	Glu	Lys	Lys	His	Val	Leu	Ser	His	Asn	
					35					40
Ser	Tyr	Glu	Lys	Thr	Lys	Asn	Asn	Glu	Asn	
					45					50
Asn	Lys	Phe	Phe	Asp	Lys	Asp	Lys	Glu	Leu	
					55					60
Thr	Met	Ser	Asn	Val	Lys	Asn	Val	Ser	Gln	
					65					70
Thr	Asn	Phe	Lys	Ser	Leu	Leu	Arg	Asn	Leu	
					75					80
Gly	Val	Ser	Glu	Asn	Ile	Phe	Leu	Lys	Glu	
					85					90
Asn	Lys	Leu	Asn	Lys	Glu	Gly	Lys	Leu	Ile	
					95					100
Glu	His	Ile	Ile	Asn	Asp	Asp	Asp	Asp	Lys	
					105					110
Lys	Lys	Tyr	Ile	Lys	Gly	Gln	Asp	Glu	Asn	
					115					120
Arg	Gln	Glu	Asp	Leu	Glu	Glu	Lys	Ala	Ala	
					125					130
Glu	Gln	Gln	Ser	Asp	Leu	Glu	Gln	Glu	Arg	
					135					140
Leu	Ala	Lys	Glu	Lys	Leu	Gln	Glu	Arg	Leu	
					145					150
Ala	Lys	Glu	Lys	Leu	Gln	Glu	Gln	Gln	Arg	
					155					160
Asp	Leu	Glu	Gln	Arg	Lys	Ala	Asp	Thr	Lys	
					165					170
Lys	Asn	Leu	Glu	Arg	Lys	Lys	Glu	His	Gly	
					175					180
Asp	Val	Leu	Ala	Glu	Asp	Leu	Tyr	Gly	Arg	
					185					190
Leu	Glu	Ile	Pro	Ala	Ile	Glu	Leu	Pro	Ser	
					195					200
Glu	Asn	Glu	Arg	Gly	Tyr	Tyr	Ile	Pro	His	
					205					210
Gln	Ser	Ser	Leu	Pro	Gln	Asp	Asn	Arg	Gly	
					215					220
Asn	Ser	Arg	Asp	Ser	Lys	Glu	Ile	Ser	Ile	
					225					230
Ile	Glu	Lys	Thr	Asn	Arg	Glu	Ser	Ile	Thr	
					235					240
Thr	Asn	Val	Glu	Gly	Arg	Arg	Asp	Ile	His	
					245					250
Lys	Gly	His	Leu	Glu	Glu	Lys	Lys	Asp	Gly	
					255					260

Ser	Ile	Lys	Pro	Glu	Gln	Lys	Glu	Asp	Lys
				265					270
Ser	Ala	Asp	Ile	Gln	Asn	His	Thr	Leu	Glu
				275					280
Thr	Val	Asn	Ile	Ser	Asp	Val	Asn	Asp	Phe
				285					290
Gln	Ile	Ser	Lys	Tyr	Glu	Asp	Glu	Ile	Ser
				295					300
Ala	Glu	Tyr	Asp	Asp	Ser	Leu	Ile	Asp	Glu
				305					310
Glu	Glu	Asp	Asp	Glu	Asp	Leu	Asp	Glu	Phe
				315					320
Lys	Pro	Ile	Val	Gln	Tyr	Asp	Asn	Phe	Gln
				325					330
Asp	Glu	Glu	Asn	Ile	Gly	Ile	Tyr	Lys	Glu
				335					340
Leu	Glu	Asp	Leu	Ile	Glu	Lys	Asn	Glu	Asn
				345					350
Leu	Asp	Asp	Leu	Asp	Glu	Gly	Ile	Glu	Lys
				355					360
Ser	Ser	Glu	Glu	Leu	Ser	Glu	Glu	Lys	Ile
				365					370
Lys	Lys	Gly	Lys	Lys	Tyr	Glu	Lys	Thr	Lys
				375					380
Asp	Asn	Asn	Phe	Lys	Pro	Asn	Asp	Lys	Ser
				385					390
Leu	Tyr	Asp	Glu	His	Ile	Lys	Lys	Tyr	Lys
				395					400
Asn	Asp	Lys	Gln	Val	Asn	Lys	Glu	Lys	Glu
				405					410
Lys	Phe	Ile	Lys	Ser	Leu	Phe	His	Ile	Phe
				415					420
Asp	Gly	Asp	Asn	Glu	Ile	Leu	Gln	Ile	Val
				425					430
Asp	Glu	Arg	Leu	Ser	Glu	Asp	Ile	Thr	Lys
				435					440
Tyr	Phe	Met	Lys	Leu	Gly	Gly	Ser	Gly	Ser
				445					450
Pro	His								
				455					

<210> 5

<211> 17

<212> PRT

<213> Artificial sequence

<220>

<223> LSA-1 Consensus sequence of 17 amino acid repeats where Xaa at position 1 is either Glu or Gly; Xaa at position 4 is Ser or Arg; Xaa at position 6 is Asp or Ser; Xaa at position 9 is Glu or Asp; Xaa at position 11 is Leu or Arg; Xaa at position 13 is Lys or Asn and Xaa at position 15 is Lys or Thr or Arg.

<400> 5

Xaa Gln Gln Xaa Asp Xaa Glu Gln Xaa Arg
5 10

Xaa Ala Xaa Glu Xaa Leu Gln
5

<210> 6
<211> 24
<212> PRT
<213> *P. falciparum* LSA-1
<220>
<223> *P. falciparum* LSA-1 T1 epitope
<400> 6
Leu Thr Met Ser Asn Val Lys Asn Val Ser
5 10
Gln Thr Asn Phe Lys Ser Leu Leu Arg Asn
15 20
Leu Gly Val Ser

<210> 7
<211> 17
<212> PRT
<213> *P. falciparum* LSA-1
<220>
<223> *P. falciparum* LSA-1 LSA-Rep epitope
<400> 7
Glu Gln Gln Ser Asp Leu Glu Gln Glu Arg
5 10
Leu Ala Lys Glu Lys Leu Gln
15

<210> 8
<211> 17
<212> PRT
<213> *P. falciparum* LSA-1
<220>
<223> *P. falciparum* LSA-1 J epitope
<400> 8
Glu Arg Leu Ala Lys Glu Lys Leu Gln Glu
5 10
Gln Gln Arg Asp Leu Glu Gln
15

<210> 9
<211> 20
<212> PRT
<213> *P. falciparum* LSA-1
<220>
<223> *P. falciparum* LSA-1 NR epitope
<400> 9

Thr	Lys	Lys	Asn	Leu	Glu	Arg	Lys	Lys	Glu
				5					10
His	Gly	Asp	Val	Leu	Ala	Glu	Asp	Leu	Tyr
				15					20

<210>	10
<211>	34
<212>	PRT
<213>	<i>P. falciparum</i> LSA-1
<220>	
<223>	<i>P. falciparum</i> LSA-1 LSA-Ter epitope
<400>	10

Asn	Ser	Arg	Asp	Ser	Lys	Glu	Ile	Ser	Ile
					5				10
Ile	Glu	Lys	Thr	Asn	Arg	Glu	Ser	Ile	Thr
				15					20
Thr	Asn	Val	Glu	Gly	Arg	Arg	Asp	Ile	His
				25					30

Lys Gly His Leu

<210>	11
<211>	9
<212>	PRT
<213>	<i>P. falciparum</i> LSA-1
<220>	
<223>	<i>P. falciparum</i> LSA-1 ls6 epitope
<400>	11

Lys Pro Ile Val Gln Tyr Asp Asn Phe

5

<210>	12
<211>	23
<212>	PRT
<213>	<i>P. falciparum</i> LSA-1
<220>	
<223>	<i>P. falciparum</i> LSA-1 T3 epitope
<400>	12

Asn	Glu	Asn	Leu	Asp	Asp	Leu	Asp	Glu	Gly
				5				10	
Ile	Glu	Lys	Ser	Ser	Glu	Glu	Leu	Ser	Glu
				15					20

Glu Lys Ile

<210>	13
<211>	7
<212>	PRT
<213>	<i>P. falciparum</i> LSA-1
<220>	
<223>	<i>P. falciparum</i> LSA-1 ls8 epitope
<400>	13

Lys Pro Asn Asp Lys Ser Leu

5

<210> 14
<211> 22
<212> PRT
<213> *P. falciparum* LSA-1
<220>
<223> *P. falciparum* LSA-1 T5 epitope
<400> 14
Asp Asn Glu Ile Leu Gln Ile Val Asp Glu
5 10
Leu Ser Glu Asp Ile Thr Lys Tyr Phe Met
15 20
Lys Leu

```

<210> 15
<211> 23
<212> PRT
<213> P. falciparum LSA-1
<220>
<223> P. falciparum LSA-1 T5-MutR epitope
<400> 15
Asp Asn Glu Ile Leu Gln Ile Val Asp Glu
                           5                      10
Arg Leu Ser Glu Asp Ile Thr Lys Tyr Phe
                           15                     20
Met Lys Leu

```

```

<210> 16
<211> 24
<212> PRT
<213> P. falciparum LSA-1
<220>
<223> P. falciparum LSA-1 LSA1.1 epitope
<400> 16
Leu Thr Met Ser Asn Val Lys Asn Val Ser
                           5                      10
Gln Thr Asn Phe Lys Ser Leu Leu Arg Asn
                           15                     20
Leu Gly Val Ser

```

```

<210> 17
<211> 20
<212> PRT
<213> P. falciparum LSA-1
<220>
<223> P. falciparum LSA-1 LSA1.2 epitope
<400> 17
His Thr Leu Glu Thr Val Asn Ile Ser Asp
                                5          10
Val Asn Asp Phe Gln Ile Ser Lys Tyr Glu
                                15         20

```

<210> 18
 <211> 18
 <212> PRT
 <213> *P. falciparum* LSA-1
 <220>
 <223> *P. falciparum* LSA-1.3 epitope
 <400> 18

Asp Glu Asp Leu Asp Glu Phe Lys Pro Ile
 5 10
 Val Gln Tyr Asp Asn Phe Gln Asp
 15

<210> 19
 <211> 13
 <212> PRT
 <213> *P. falciparum* LSA-1
 <220>
 <223> *P. falciparum* LSA-1 LSA1.4 epitope
 <400> 19

Ile Gly Ile Tyr Lys Glu Leu Glu Asp Leu
 5 10
 Ile Glu Lys

<210> 20
 <211> 23
 <212> PRT
 <213> *P. falciparum* LSA-1
 <220>
 <223> *P. falciparum* LSA-1 LSA1.5 epitope
 <400> 20

Asn Glu Asn Leu Asp Asp Leu Asp Glu Gly
 5 10
 Ile Glu Lys Ser Ser Glu Glu Leu Ser Glu
 15 20
 Glu Lys Ile

<210> 21
 <211> 15
 <212> PRT
 <213> *P. falciparum* LSA-1
 <220>
 <223> *P. falciparum* LSA-1 LSA1.6 epitope
 <400> 21

Ile Lys Lys Gly Lys Lys Tyr Glu Lys Thr
 5 10
 Lys Asp Asn Asn Phe
 15

<210> 22
 <211> 22
 <212> PRT

cgatgacaaa	aaaaaaataca	ttaaaggcca	ggatgaaaat	360
cgccaggaag	acctcgaaga	aaaagctgct	gaacagcagt	400
cggacctgga	acaggagcgc	ctcgctaaag	aaaagctcca	440
ggagcgcctc	gctaaagaaa	agctccagga	gcaacagcgc	480
gaccttggAAC	agcgcaaggc	tgacacgaaa	aaaaacctgg	520
aacgcaaaaa	ggaacacggc	gacgttctgg	ctgaggacct	560
gtacggccgc	ctggaaatcc	cagctatcga	actcccattcc	600
gaaaacgaac	gcggctacta	catcccacac	cagagcagcc	640
tgccacaaga	taatcgcggg	aactcccgcg	acagtaagga	680
aatcagcatc	atcgaaaaaa	ccaaccgcga	aagcattacc	720
accaacgtgg	aaggccgccc	cgacatccac	aaaggccacc	760
tcgaagaaaa	gaaagacggc	tccatcaaac	cagaacagaa	800
agaagacaaa	agcgctgata	tccagaacca	caccctggag	840
accgtgaaca	ttagcgacgt	gaacgacttc	cagatcagca	880
agtacgagga	cggaaatctcc	gctgaatacg	atgactccct	920
gatcgacgaa	gaagaagacg	acgaagatct	ggatgaattc	960
aaaccaattg	tccagtgacg	taactttcag	gacgaagaaa	1000
atatcgcat	ttacaaaagaa	ctcgaagacc	tcatcgagaa	1040
aaacgaaaac	ctggacgacc	tggacgaaagg	catcgaaaaa	1080
tcctccgaag	aactgagcga	agaaaaaaatc	aaaaaaggca	1120
agaaatacga	aaaaaaccagg	gacaacaact	tcaaaacccaa	1160
cgacaaatcc	ctctacgacg	agcacattaa	aaaatacaca	1200
aacgacaaggc	aagtgaacaa	ggaaaaggaa	aaatttatca	1240
aatccctctt	ccacatcttc	gatggcgata	acgaaattct	1280
gcaaattgt	gacgaactga	gcaagacat	cactaaatac	1320
ttcatgaagc	ttgggggctc	cgggtctcca	caccaccacc	1360
accaccactg a				1371

<210> 26
 <211> 456
 <212> PRT
 <213> Artificial sequence
 <220>
 <223> LSA-NRC(H) protein
 <400> 26

Met	Gly	Thr	Asn	Ser	Glu	Lys	Asp	Glu	Ile
					5			10	
Ile	Lys	Ser	Asn	Leu	Arg	Ser	Gly	Ser	Ser
					15			20	
Asn	Ser	Arg	Asn	Arg	Ile	Asn	Glu	Glu	Lys
					25			30	
His	Glu	Lys	Lys	His	Val	Leu	Ser	His	Asn
					35			40	
Ser	Tyr	Glu	Lys	Thr	Lys	Asn	Asn	Glu	Asn
					45			50	
Asn	Lys	Phe	Phe	Asp	Lys	Asp	Lys	Glu	Leu
					55			60	
Thr	Met	Ser	Asn	Val	Lys	Asn	Val	Ser	Gln
					65			70	
Thr	Asn	Phe	Lys	Ser	Leu	Leu	Arg	Asn	Leu
					75			80	
Gly	Val	Ser	Glu	Asn	Ile	Phe	Leu	Lys	Glu
					85			90	

Asn	Lys	Leu	Asn	Lys	Glu	Gly	Lys	Leu	Ile	
				95						100
Glu	His	Ile	Ile	Asn	Asp	Asp	Asp	Asp	Lys	
				105						110
Lys	Lys	Tyr	Ile	Lys	Gly	Gln	Asp	Glu	Asn	
				115						120
Arg	Gln	Glu	Asp	Leu	Glu	Glu	Lys	Ala	Ala	
				125						130
Glu	Gln	Gln	Ser	Asp	Leu	Glu	Gln	Glu	Arg	
				135						140
Leu	Ala	Lys	Glu	Lys	Leu	Gln	Glu	Arg	Leu	
				145						150
Ala	Lys	Glu	Lys	Leu	Gln	Glu	Gln	Gln	Arg	
				155						160
Asp	Leu	Glu	Gln	Arg	Lys	Ala	Asp	Thr	Lys	
				165						170
Lys	Asn	Leu	Glu	Arg	Lys	Lys	Glu	His	Gly	
				175						180
Asp	Val	Leu	Ala	Glu	Asp	Leu	Tyr	Gly	Arg	
				185						190
Leu	Glu	Ile	Pro	Ala	Ile	Glu	Leu	Pro	Ser	
				195						200
Glu	Asn	Glu	Arg	Gly	Tyr	Tyr	Ile	Pro	His	
				205						210
Gln	Ser	Ser	Leu	Pro	Gln	Asp	Asn	Arg	Gly	
				215						220
Asn	Ser	Arg	Asp	Ser	Lys	Glu	Ile	Ser	Ile	
				225						230
Ile	Glu	Lys	Thr	Asn	Arg	Glu	Ser	Ile	Thr	
				235						240
Thr	Asn	Val	Glu	Gly	Arg	Arg	Asp	Ile	His	
				245						250
Lys	Gly	His	Leu	Glu	Glu	Lys	Lys	Asp	Gly	
				255						260
Ser	Ile	Lys	Pro	Glu	Gln	Lys	Glu	Asp	Lys	
				265						270
Ser	Ala	Asp	Ile	Gln	Asn	His	Thr	Leu	Glu	
				275						280
Thr	Val	Asn	Ile	Ser	Asp	Val	Asn	Asp	Phe	
				285						290
Gln	Ile	Ser	Lys	Tyr	Glu	Asp	Glu	Ile	Ser	
				295						300
Ala	Glu	Tyr	Asp	Asp	Ser	Leu	Ile	Asp	Glu	
				305						310
Glu	Glu	Asp	Asp	Glu	Asp	Leu	Asp	Glu	Phe	
				315						320
Lys	Pro	Ile	Val	Gln	Tyr	Asp	Asn	Phe	Gln	
				325						330
Asp	Glu	Glu	Asn	Ile	Gly	Ile	Tyr	Lys	Glu	
				335						340
Leu	Glu	Asp	Leu	Ile	Glu	Lys	Asn	Glu	Asn	
				345						350
Leu	Asp	Asp	Leu	Asp	Glu	Gly	Ile	Glu	Lys	
				355						360

Ser	Ser	Glu	Glu	Leu	Ser	Glu	Glu	Lys	Ile	
				365						370
Lys	Lys	Gly	Lys	Lys	Tyr	Glu	Lys	Thr	Lys	
				375						380
Asp	Asn	Asn	Phe	Lys	Pro	Asn	Asp	Lys	Ser	
				385						390
Leu	Tyr	Asp	Glu	His	Ile	Lys	Lys	Tyr	Lys	
				395						400
Asn	Asp	Lys	Gln	Val	Asn	Lys	Glu	Lys	Glu	
				405						410
Lys	Phe	Ile	Lys	Ser	Leu	Phe	His	Ile	Phe	
				415						420
Asp	Gly	Asp	Asn	Glu	Ile	Leu	Gln	Ile	Val	
				425						430
Asp	Glu	Leu	Ser	Glu	Asp	Ile	Thr	Lys	Tyr	
				435						440
Phe	Met	Lys	Leu	Gly	Gly	Ser	Gly	Ser	Pro	
				445						450
His										
										455

<210> 27
<211> 9
<212> PRT
<213> Artificial sequence
<220>
<223> derived LSA-1 peptide PL910
<400> 27
Val Ser Gln Thr Asn Phe Lys Ser Leu
5

<210> 28
<211> 8
<212> PRT
<213> Artificial sequence
<220>
<223> derived LSA-1 peptide PL911
<400> 28
Ser Gln Thr Asn Phe Lys Ser Leu
5